[54] **COMPUTERIZED METHOD FOR IMPROVING DATA RESOLUTION**

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[56] **References Cited**

U.S. PATENT DOCUMENTS

3,573,789	4/1971	Sharp et al.	340/324
4,437,122	3/1984	Walsh et al.	358/166
4,783,840	11/1988	Song	382/261
4,941,190	7/1990	Joyce	382/264
5,151,783	9/1992	Faroudja	348/448
5,270,836	12/1993	Kang	358/459
5,282,057	1/1994	Mailloux et al.	358/445
5,377,018	12/1994	Rafferty	358/433
5,446,804	8/1995	Allebach et al.	382/298
5,528,339	6/1996	Buhr et al.	355/32
5,539,866	7/1996	Banton et al.	395/117
5,579,445	11/1996	Loce et al.	395/102
5,636,290	6/1997	Kita et al.	382/167
5,668,895	9/1997	Yamazaki et al.	382/260
5,671,298	9/1997	Markandey et al.	358/298
5,689,343	11/1997	Loce et al.	358/298
5,703,618	12/1997	Eglit	345/112
5,717,789	2/1998	Anderson et al.	382/254
5,734,802	3/1998	Maltz et al.	395/109
5,758,034	5/1998	Loce et al.	395/102
5,778,158	7/1998	Fujii et al.	395/102
5,796,873	8/1998	Deane	382/254

OTHER PUBLICATIONS

MIT Tech. Rpt. #234, Nov. 8–11, 1993, Novel cluster–based probability model for texture synthesis, classification, and compression, Popat and Picard.

1994 IEEE 0–7803–1775–0/94, Cluster–Based Probability Model Applied to Image Restoration and Compression, Popat and Picard.

1990 IEEE 0090–6778/90/0900–1285, Optimal Nonlinear Interpolative Vector Quantization, by Allen Gersho.

MIT MLPCS Tech. Report No. 351, Cluster–based probability model and its application to image and texture processing Popat and Picard, not dated.

The Hard Copy Observer, vol. VII No. 4, Apr. 1997, "HP and WebTV to Provide TV Set Top Printing Solution", pp. 2, 49–50.

William K. Pratt, Digital Image Processing, 2nd Edition, ISBN 0–471–85766–01, pp. 142–146, 1991.

Adobe Photoshop User Guide, Adobe Systems Inc., pp. 12–19, 1993.

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[57] **ABSTRACT**

A data resolution synthesis algorithm takes low resolution source input data (e.g., data degraded from compression or data acquired from low quality imaging devices) to synthesize high resolution output data. In an exemplary embodiment for color printing, the algorithm is performed by characterizing a multi-pixel area, or window, around a pixel that can benefit from resolution enhancement. To interpolate to a high resolution output a set of spatial filters is applied to the data area based on the window characterization. The output of the resolution synthesizer is a set of multiple pixels for each input pixel, representing the source input pixel in a higher resolution enhanced version. The filters are chosen from a stored data base (generic or specifically applicable data base for each type input device) created to fit input/output device requirements.

16 Claims, 12 Drawing Sheets

(1 of 12 Drawing Sheet(s) Filed In Color)